1. Verify the equivalences \( \neg P \rightarrow Q \equiv P \lor Q \) and \( (A \rightarrow C) \land (B \rightarrow C) \equiv (A \lor B) \rightarrow C \) mentioned in the style manual, using truth tables.

Use a truth table to support the assertion that \( (A \rightarrow C) \lor (B \rightarrow C) \) does NOT always imply \( (A \lor B) \rightarrow C \). Hint: highlight a row in your table.

2. Write a proof of \( ((P \rightarrow Q) \land (Q \rightarrow R)) \rightarrow (P \rightarrow R) \) in the style presented in class and in the style manual.

3. The following is the inference rule of destructive dilemma. Verify it using our system of rules. You can use the proof of constructive dilemma which appears as an example in the style manual as a model.

\[
\begin{align*}
P & \rightarrow Q \\
R & \rightarrow S \\
\neg Q \lor \neg S & \\
\hline
\neg P \lor \neg R
\end{align*}
\]

This will be a proof by cases!

4. Write a proof of \( ((P \rightarrow Q) \land (\neg P \rightarrow Q)) \rightarrow Q \) in the style presented in class and in the style manual. I can see two ways to do this. You could start by proving \( P \lor \neg P \) (which is very short though you might have to think a little to see how it works), or you could prove the contrapositive.

5. Write a proof of \( ((P \land Q) \lor (\neg Q \land R)) \rightarrow (P \lor R) \) in the style presented in the style manual.